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# **SITE MANAGEMENT AND MONITORING PLAN**

FOR THE  
  
**WILMINGTON  
OCEAN DREDGED MATERIAL DISPOSAL SITE**


**NOVEMBER 1996**

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The following Site Management Plan for the Wilmington ODMDS has been developed and agreed to pursuant to the Water Resources Development Act Amendments of 1992 (WRDA 92) to the Marine Protection, Research, and Sanctuaries Act of 1972 for the management and monitoring of ocean disposal activities, as resources allow, by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers.

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This plan is effective from date of signature for a period not to exceed 10 years. The plan shall be reviewed and revised more frequently if site use and conditions at site indicate a need for revision.

# SITE MANAGEMENT AND MONITORING PLAN FOR THE WILMINGTON OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS)

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**SITE MANAGEMENT AND MONITORING PLAN  
FOR THE  
WILMINGTON OCEAN DREDGED MATERIAL DISPOSAL SITE  
(ODMDS)  
November 1996**

## **INTRODUCTION**

Under the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, it is the responsibility of the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (CE) to monitor and manage Ocean Dredged Material Disposal Sites (ODMDS) to ensure that ocean dredged material disposal activities will not unreasonably degrade the marine environment or endanger human health or economic potentialities. MPRSA, the Water Resources Development Act (WRDA) of 1992, and a Memorandum of Agreement Between EPA and CE require the development of a site management and monitoring plan (SMMP) to specifically address the disposal of dredged material at the Wilmington ODMDS. Following an opportunity for public review and comment, SMMP provisions shall be requirements for all dredged material disposal activities at the site. **All Section 103 (MPRSA) ocean disposal permits or evaluations shall be conditioned as necessary to assure consistency with the SMMP.**

This SMMP has been prepared in accordance with Guidance Document for Development of Site Management Plans for Ocean Dredged Material Disposal Sites dated February 1996, which was prepared by the EPA and the CE. This document provides a framework for the development of site monitoring and management plans required by MPRSA and WRDA. The SMMP may be modified if it is determined that such changes are warranted as a result of information obtained during the monitoring process. The SMMP shall be reviewed and revised at least every 10 years.

## **SCOPE OF THE SMMP**

ODMDS management involves a broad range of activities including regulating the schedule of use, the quantity, and the physical/chemical characteristics of dredged materials dumped at the site. It also involves establishing disposal controls, conditions and requirements to avoid and minimize potential impacts to the marine environment. Finally, ODMDS management involves monitoring the site environs to verify that unanticipated or significant adverse effects are not occurring from past or continued use of the site and that permit conditions are met.

MPRSA, as amended by WRDA 1992, provides that the SMMP shall include but not be limited to:

- A baseline assessment of conditions at the site;
- A program for monitoring the site;
- Special management conditions or practices to be implemented at each site that are necessary for the protection of the environment;
- Consideration of the quantity and physical/chemical characteristics of dredged materials to be disposed of at the site;
- Consideration of the anticipated use of the site over the long term;
- A schedule for review and revision of the plan.

## OBJECTIVES OF SITE MANAGEMENT

There are three primary objectives in the management of the Wilmington ODMDS:

- Protection of the marine environment, living resources, and human health and welfare;
- Documentation of disposal activities at the ODMDS and provision of information which is useful in managing the dredged material disposal activities;
- Provision for beneficial use of dredged material whenever practical.

The objective of the SMMP is to provide guidelines in making management decisions necessary to fulfill mandated responsibilities to protect the marine environment as discussed previously. Risk-free decision making is an impossible goal, however, an appropriate SMMP can narrow the uncertainty.

## WILMINGTON OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS)

The Wilmington ODMDS (Figures 1 and 2) was designated by EPA pursuant to Section 102(c) of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, as suitable for the ocean disposal of dredged material. The final rule was promulgated by EPA on 02 July 1987 (FR. Vol. 52 No. 127), effective 03 August 1987. The boundary coordinates for the Wilmington ODMDS are:

(Assumed to be NAD 27 Geographic) (NAD 83 State Plane - Feet)

33° 49'30" N	78° 03'06" W	N 28739	E 2288161
33° 48'18" N	78° 01'39" W	N 21531	E 2295573
33° 47'19" N	78° 02'48" W	N 15510	E 2289807
33° 48'30" N	78° 04'16" W	N 22617	E 2282311



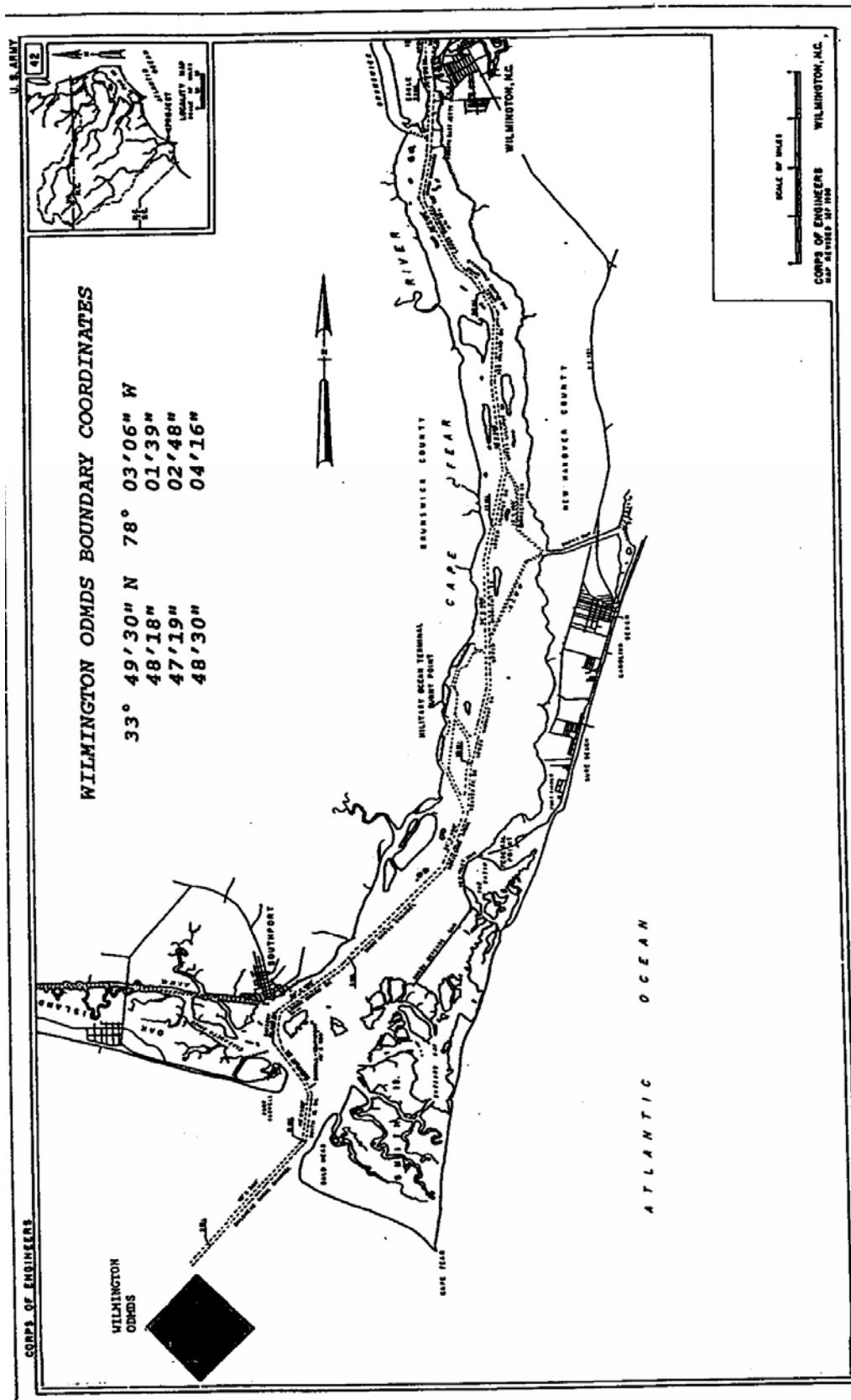
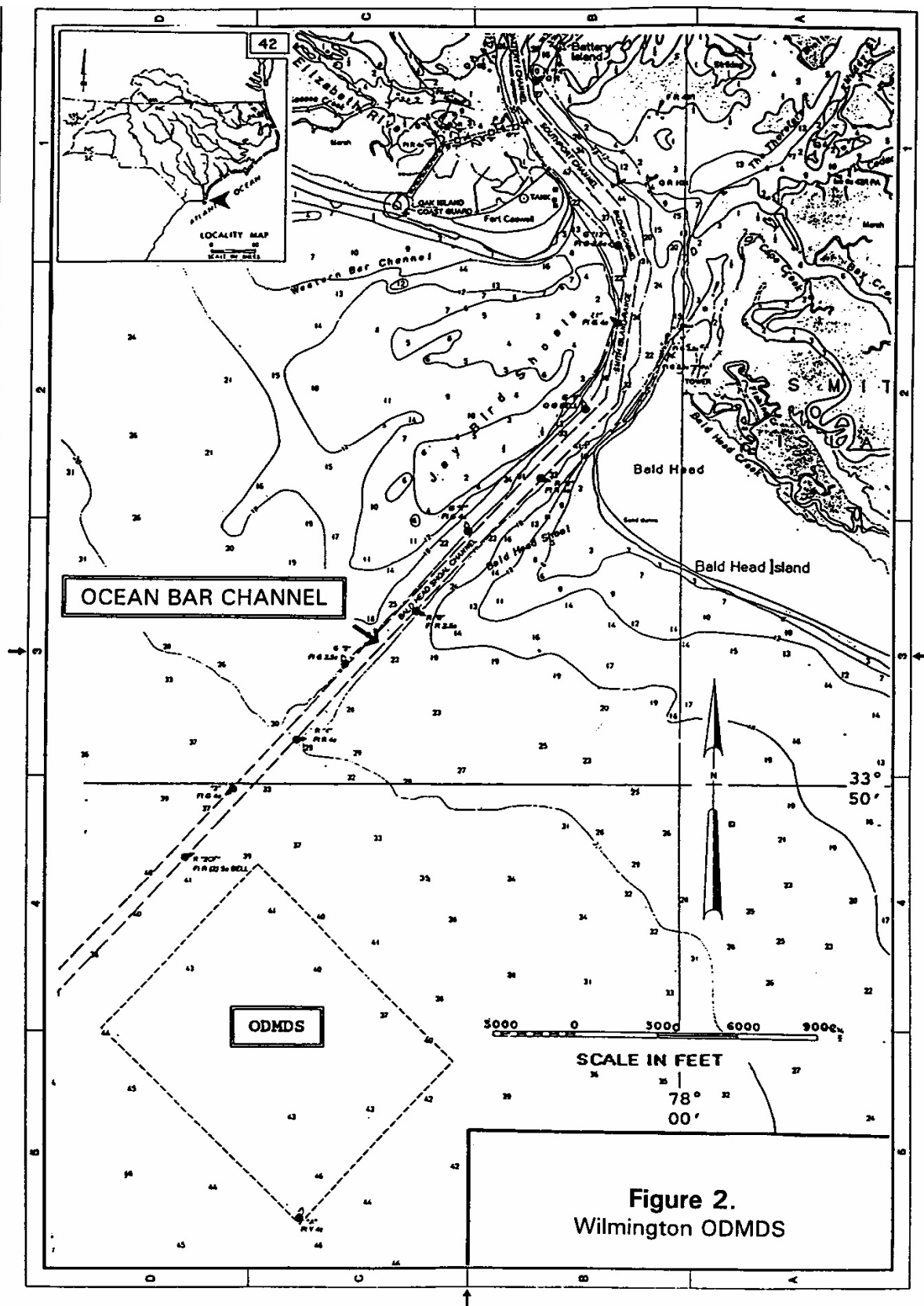


Figure 1. Wilmington Ocean Dredged Material Disposal Site (ODMDS)



**Figure 2.**  
Wilmington ODMDS

The Wilmington ODMDS is located just beyond 3 nautical miles offshore and thus lies within the contiguous zone. The ODMDS has an area of about 2.3-square nautical miles. Depths within the ODMDS range from about -20 to -44 feet mean lower low water (m.l.l.w.) (based on a February 1996 bathymetric survey). The depths less than -25 feet m.l.l.w. occurred in two distinct mounds. One of those mounds has been subsequently lowered to below -25 feet m.l.l.w. by a hopper dredge. The bathymetry is gently sloping from north to south.

## DISPOSAL HISTORY

**Historical Use of the Wilmington ODMDS.** Disposal of dredged materials in the ocean has been associated with the Wilmington Harbor Federal navigation project and the Military Ocean Terminal Sunny Point (MOTSU) for many years. The Cape Fear River ocean bar channel has been maintained by the Federal Government for well over 100 years. The Wilmington Harbor Federal navigation project consists of a series of channels or "reaches" extending from the ocean bar channel at the mouth of the Cape Fear River to a point above Wilmington, North Carolina (Figure 3). Continued use of the Wilmington Harbor navigation channel depends upon maintenance dredging. Annual maintenance dredging is required at project extremes, the ocean bar and anchorage basin and approaches at Wilmington. Reaches or channels between those extremes require maintenance but generally less frequently and with less volume of dredged material than the ocean bar channels or the anchorage basin and approaches at Wilmington. MOTSU is a military port facility located on the west bank of the Cape Fear River, approximately 10 miles upstream from the river's mouth. MOTSU requires annual maintenance dredging to meet its mission requirements. The dredged material disposal methods for a particular reach or facility depend on characteristics of the dredged material, the availability of disposal capacity, and the type of dredge equipment used. Dredged materials placed in the Wilmington ODMDS come from three general areas within the Cape Fear River: the Wilmington Harbor Federal navigation project - ocean bar channels (WH-OB); the Wilmington Harbor Federal navigation 38-foot project, the navigation channel to Wilmington excluding the ocean bar and portions above the Lower Brunswick channel (WH-38); and the Military Ocean Terminal Sunny Point (MOTSU). Channel sediments upstream of the Lower Brunswick channel are placed in upland confined disposal areas.

Since 1976, approximately 24.2 million cubic yards of dredged materials have been disposed of in the Wilmington ODMDS area (Table 1). Since 1987 (the date of site designation), approximately 16.7 million cubic yards of dredged materials have been placed within the Wilmington

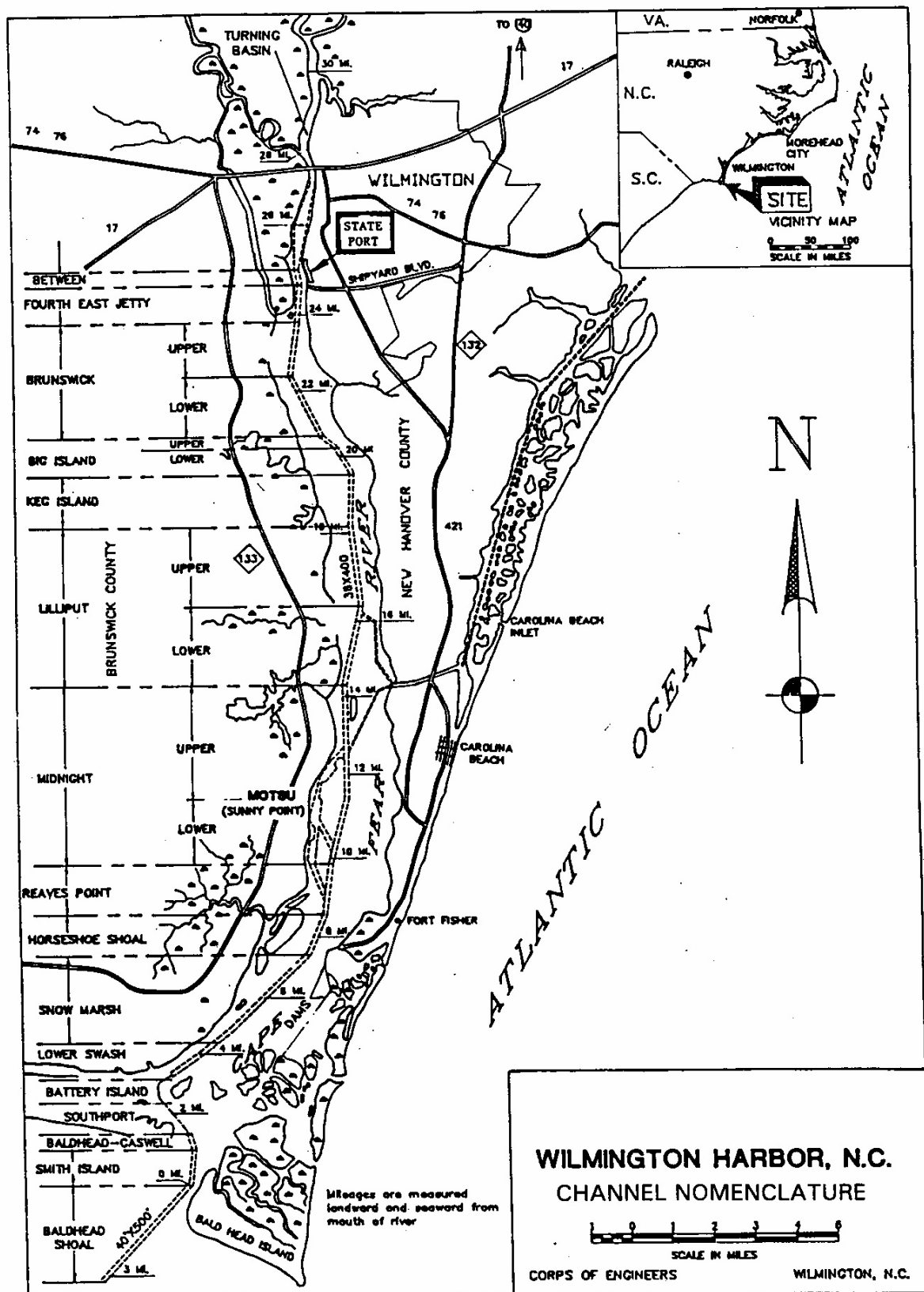


Figure 3.

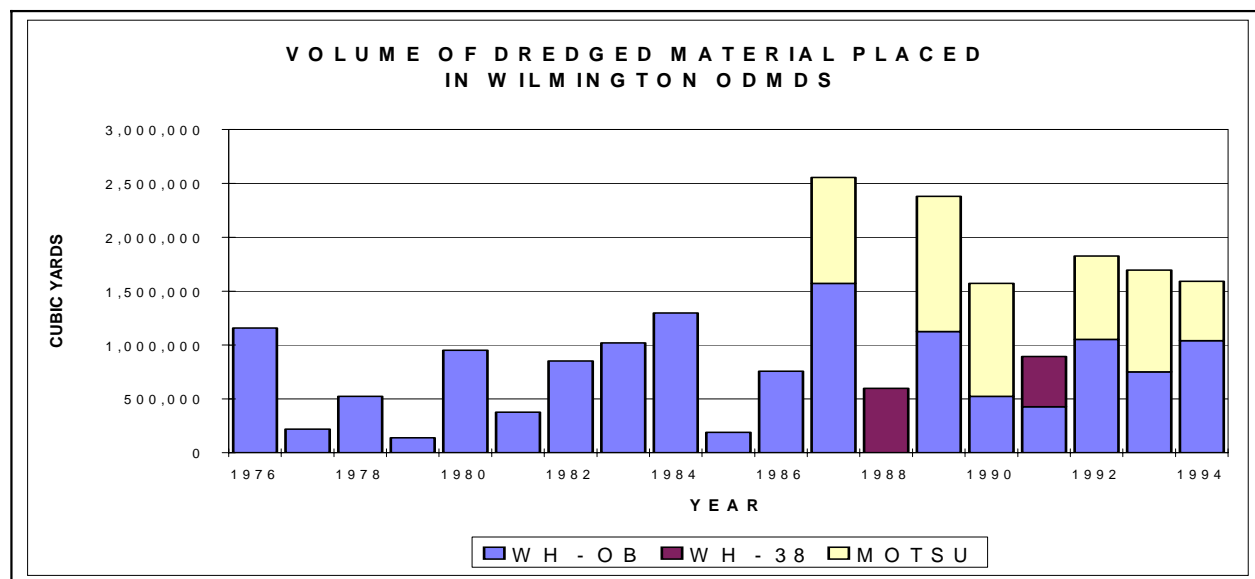
ODMDS. Between 1976 and 1986, the average annual volume of dredged materials placed in the ocean was about 0.68 million cubic yards. Between 1987 and 1995, the average annual volume of dredged material ocean disposed was about 1.86 million cubic yards. Figure 4 shows the yearly record of ocean dredged material disposal in the Wilmington ODMDS area for 1976 through 1995. As shown in Figure 4, the site use changed in 1987 when MOTSU and the Wilmington Harbor 38 foot project began to use the Wilmington ODMDS. The percentage of each source of dredged material placed within the Wilmington ODMDS is shown in Figure 5.

**Table 1.** Volume of dredged materials placed in the Wilmington ODMDS area. WH-OB - Wilmington Harbor ocean bar; WH-38 - Wilmington Harbor 38-foot project; MOTSU - Military Ocean Terminal Sunny Point.

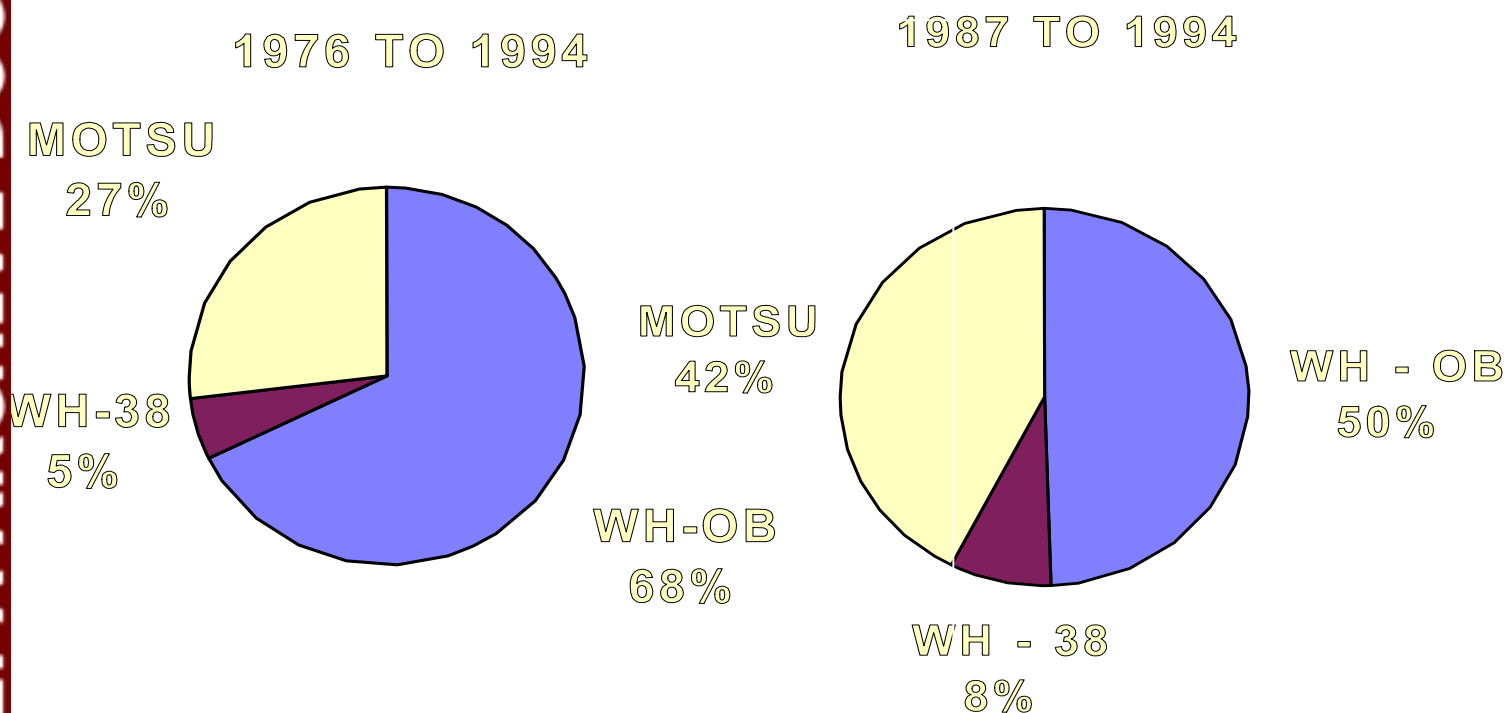
DREDGED MATERIAL QUANTITY - CUBIC YARDS				
YEAR	WH-OB	WH-38	MOTSU	YEAR TOTAL
1976	1,157,161	0	0	1,157,161
1977	218,624	0	0	218,624
1978	523,803	0	0	523,803
1979	138,817	0	0	138,817
1980	951,935	0	0	951,935
1981	376,942	0	0	376,942
1982	850,621	0	0	850,621
1983	1,018,839	0	0	1,018,839
1984	1,297,202	0	0	1,297,202
1985	190,633	0	0	190,633
1986	756,423	0	0	756,423
1987	1,571,976	0	983,250	2,555,226
1988	0	597,568	0	597,568
1989	1,124,408	0	1,255,134	2,379,542
1990	524,267	0	1,047,290	1,571,557
1991	427,176	466,349	0	893,525
1992	1,051,328	0	773,950	1,825,278
1993	749,800	0	945,255	1,695,055
1994	1,040,600	0	549,770	1,590,370
1995	1,594,295	1,633,852	398,111	3,626,258
1976-1995	15,564,850	2,697,769	5,952,760	24,215,379
1987-1995	8,083,850	2,697,769	5,952,760	16,734,379

Note: WH-OB - Baldhead Shoal through Battery Island channels, inclusive  
 WH-38- Lower Swash through portions of Lower Brunswick channels  
 MOTSU - Materials associated with MOTSU only

**Figure 4.** Volume of dredged material placed in the Wilmington ODMDs area, 1976 - 1994.



**Figure 5.** Sources of dredged materials placed within the Wilmington ODMDs.



Note: MOTSU - Military Ocean Terminal, Sunny Point, a Section 103 permitted facility.  
 WH-OB - Wilmington Harbor Federal navigation project, ocean bar channel  
 WH-38 - Wilmington Harbor Federal navigation project, 38 foot project, river channels.



### Characteristics of Dredged Materials

**Grain Size.** The sediments dredged from navigation channels in the Cape Fear River include ocean source (sandy, littoral materials), river source (fine grained sands, silts, and clays derived from easily eroded soils from the upper Cape Fear River basin), and mixtures of both. Shoals occur where specific physical factors promote deposition or movement of sediments. The characteristics of the shoal material at a specific channel location are dependent on many factors which may vary temporally. Table 2 indicates the grain size characteristics of Wilmington Harbor channel sediments and divides the Wilmington Harbor project into broad groups by sediment characteristics. Based on the grain size data provided, some Wilmington Harbor channel sediments have significant silt and clay components and therefore do not meet Part 227.13(b) criteria for exclusion from further evaluation. For those materials, additional information is necessary to determine compliance with the Regulations and Criteria.

**Table 2.** Grain size characteristics of Wilmington Harbor and MOTSU channel sediments.

<u>Channel</u>	<u>%Gravel</u>	<u>%Sand</u>	<u>% Silt &amp; Clay</u>	<u>Sediment Grouping</u>
Bald Head Shoal				
Offshore reaches	0.0	73.2	26.8 ]	Silty Offshore
Inlet Reaches	0.0	98.7	1.3 --	
Smith Island	7.9	92.0	0.1	Sandy Lower Project Reaches
Caswell-Southport	18.0	80.5	1.5	
Southport	12.5	85.5	2.0	
Battery Island	38.0	61.0	1.0	
Lower Swash	27.0	70.0	3.0	
Horseshoe Shoal	0.0	98.0	2.0	Varied Mid-Project Reaches
Reaves Point	0.0	99.0	1.0 --	
Lower Midnight	0.0	76.0	24.0 --	
Upper Midnight	0.0	82.5	17.5	
Lower Lilliput	0.0	53.5	46.5	
Upper Lilliput	0.0	98.0	2.0	Silty Upper-Project Reaches
Keg Island	0.0	63.0	37.0	
Upper and Lower Big Island	2.0	94.0	3.0	
Lower Brunswick	0.0	92.7	7.3	
Upper Brunswick	0.0	57.0	43.0	
Fourth East and Between	0.0	80.0	20.0 --	Silty Riverine
Anchorage Basin	0.0	6.0	94.0 --	
Between Memorial and	10.0	55.0	35.0	
Hilton Railroad Bridges				
Above Hilton Railroad Bridge	0.0	58.0	42.0 --	
MOTSU*	0.0	30.0	70.0 ]	

Note: Gravel - grain size larger than 5.0 mm  
Sand - grain size between 0.07 and 5.0 mm  
Silt and Clay - grain size smaller than 0.07 mm

Source: USACE 1996 except for \* which is USACE 1993.

**Chemical and Biological Testing of Sediments.** Representative samples of fine-grained sediments from the Wilmington Harbor channels and the MOTSU basins which are dredged and placed in the Wilmington ODMDs have been chemically and biologically tested several times since 1978. These evaluations are divided into pre-1991 and post-1991 categories and summarized in the following paragraphs. The pre-1991 data was collected using the 1977 testing manual Ecological Evaluation of Proposed Discharge of Dredged Material Into Ocean Waters. The Post-1991 data was collected according to the 1991 testing manual, Evaluation of Dredged Material Proposed for Ocean Disposal. The 1991 "Testing Manual" is believed to contain technical improvements to the 1977 "Testing Manual" which improve the ability to draw meaningful, technically sound conclusions regarding the suitability of dredged material for ocean disposal. Accordingly, emphasis is given to the post-1991 data.

**Pre-1990 Sediment Evaluations.** A summary of 1978-1989 sediment test data for Wilmington Harbor and MOTSU ocean dredged material disposal is presented in Table 3. The general sample locations for these analyses are shown in Figure 6. This data was extracted from the following reports:

EG and G, Bionomics. 1978. Laboratory Evaluation of the Toxicity of Material to be Dredged from the Outer Ocean Bar of the Cape Fear River, N.C. Prepared Under Contract to the U.S. Army Corps of Engineers, Wilmington District.

Jones, Edmunds, and Associates, Inc. 1979. Grain Size Analysis, Bioassays, and Bioaccumulation Potential Assessment, Access Channels and Anchorage Basins, Military Ocean Terminal, Sunny Point, N.C. Prepared Under Contract to the U.S. Army Corps of Engineers, Wilmington District.

Jones, Edmunds, and Associates, Inc. 1980. Grain Size Analysis, Bioassays, and Bioaccumulation Potential Assessment, Smith Island and Baldhead Shoal Channels, Wilmington Harbor, N.C. Prepared by Under Contract to the U.S. Army Corps of Engineers, Wilmington District.

U.S. Army Corps of Engineers, Wilmington District. 1986. Environmental Assessment, Maintenance Dredging with Clamshell Dredge and Ocean Dumping, Keg Island to Snow Marsh Channels, Wilmington Harbor, N.C., November 1986. Appendices A and B Summarizes Chemical and Biological Analyses of Keg Island Channel Sediments. Unpublished data, New York Testing Laboratories, Inc. Under Contract to Wilmington District.

U.S. Environmental Protection Agency. 1989. Biological and Chemical Assessment of Sediments From Proposed Dredge Sites in Military Ocean Terminal Sunny Point, N.C., Prepared by Environmental Research Laboratory, Gulf Breeze, FL. Under Contract to the U.S. Army Corps of Engineers, Wilmington District.

U.S. Environmental Protection Agency. 1989. Studies With Sediment From the Proposed Wilmington Harbor Passing Lane, N.C. and Representative Marine Organisms, Prepared by Environmental Research Laboratory, Gulf Breeze, FL. Under Contract to the U.S. Army Corps of Engineers, Wilmington District.

**Table 3. Summary of 1978-1989 sediment test data.**



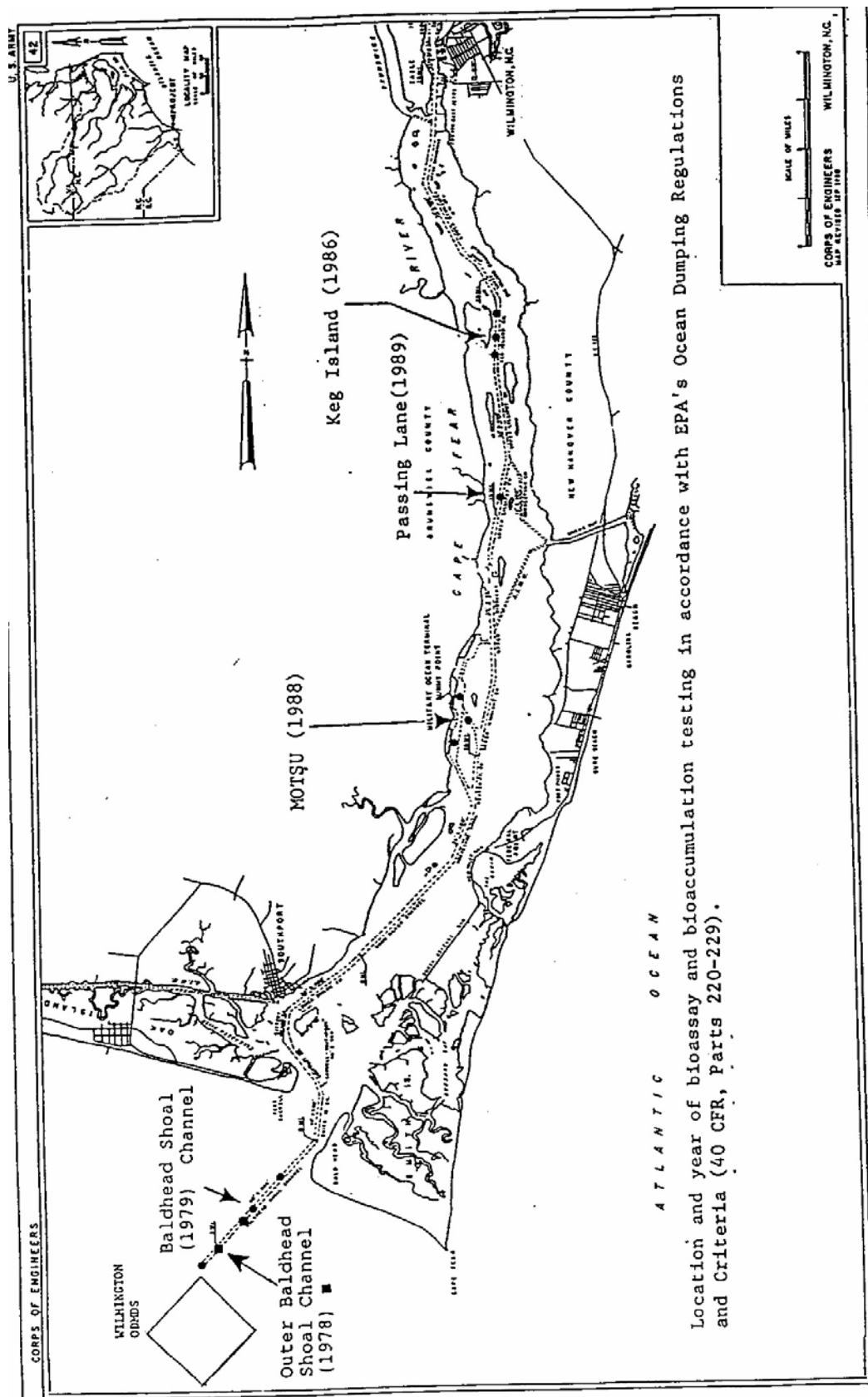


Figure 6. Sediment sample locations pre-1990.

Table 3. SUMMARY OF 1978-1989 SEDIMENT TEST DATA FOR WILMINGTON HARBOR & MOTSU OCEAN DISPOSAL

LOCATION	SUBJECT	LP-ASS-96HR MORTALITY FOR 96-HR LC50 STA 1 STA 2	SPP-ASS-96HR MORTALITY FOR 96-HR LC50 STA 1 STA 2	US-ASS-100AY MORTALITY	PEST/PCB	METALS	HYDROCARBONS ALIPH. AROM. PETROL.	CYANIDE	PHENOL	OIL/GREASE
PASSING LAKE 1989 (Lower Lilliput Channel)	SEDIMENT CHEMISTRY:									
	MYSDOPSIS		1 NS			ND	D	D	D	
	CRASSOSTREA			1 NS		ND	NS	NS	NS	
	HEREIS					ND	NS	NS	NS	
	PENAEUS			1 NS		ND	NS	NS	NS	
MOTSU BASINS 1988	SEDIMENT CHEMISTRY:									
	CRASSOSTREA		1 NS	1 NS		ND	D	D	D	
	HEREIS		1 NS	1 NS		ND	S	NS	NS	
	PENAEUS		1 NS	1 NS		ND	NS	NS	NS	
KEG ISLAND CHANNEL 1986	SEDIMENT CHEMISTRY:									
	ACARTIA		1 S			ND	D			D
	MYSDOPSIS		1 S							
	NERIDIA		1 N	1 NS		ND	NS	NS	NS	
	MERCENARIA			1 NS		ND	NS	NS	NS	
	HEREIS			1 NS		ND	NS	NS	NS	
	PALAEONETES			1 NS		ND	NS	NS	NS	
BALDHEAD SHOAL/SMITH ISLAND CHANNELS 1979	SEDIMENT CHEMISTRY:									
	ACARTIA	3 NS				ND	D	D	D	D
	NERIDIA	3 NS	1 S, 2 NS							
	NEOMYSIS	1 S, 2 NS	3 NS	1 NS		ND	NS	ND	ND	
	MERCENARIA			1 NS		ND	NS	NS	NS	
	PALAEONETES			1 NS		ND	NS	NS	NS	
	NEANTHES			1 NS						
MOTSU 1979	SEDIMENT CHEMISTRY - 14 wk lapse									
	ACARTIA	3 NS	3 NS			ND	D	D	D	D
	NERIDIA	3 NS	1 S, 2 NS							
	NEOMYSIS	3 NS	3 NS							
	MERCENARIA			3 NS		ND	NS	NS	NS	
	PALAEONETES			3 NS						
	NEANTHES			3 NS						
OUTER BALDHEAD SHOAL CHANNEL 1978	NO SED CHEMISTRY									
	ACARTIA	2 S	90%, 94%	1 S, 1 NS						
	CYPRINODON	2 S	64%, 79%	2 NS						
	MYSDOPSIS	2 S	70%, 55%	1 S, 1 NS						
	MERCENARIA									
	PARAHAUSTORIUS									
	PENAEUS									

TEST TYPE: LP-ASS = LIQUID PHASE BIOASSAY; SPP-ASS = SUSPENDED PARTICULATE PHASE BIOASSAY; NS = WHOLE-SEDIMENT BIOASSAY  
 TEST RESULTS: D = DETECTED; N = NONE; ND = NONE DETECTED; NS = NOT SIGNIFICANT (BUT DETECTED); S = SIGNIFICANT; NUMBER = NUMBER OF BIOASSAY STATIONS  
 BLANK SPACES = NO TEST DONE; LC50 = LETHAL CONCENTRATION (to 50% of test animals); LPC = LIMITING PERMISSIBLE CONCENTRATION

**Post 1991 Biological and Chemical Testing.** Sediment samples for chemical and biological evaluations were collected 30 June 1992 and 01 July 1992 from locations shown on Figure 7. At each site, five stations were sampled and then composited into a single sample representing a test treatment for biological and chemical testing. The results of these TIER III sediment evaluations are reported in Ecological Evaluation of Proposed Dredged Material From Wilmington Harbor, North Carolina, July 1993. These data indicated that Wilmington Harbor and MOTSU channel sediments were evaluated according to EPA's Ocean Dumping Regulations and Criteria and found acceptable for ocean disposal.

**Disposal Methods.** Disposal of dredged material at the Wilmington ODMDS has occurred using two methods, by hopper dredge, and by tug and barge or scow. For "ocean bar" reaches, shoal material is usually removed and transported to the ODMDS by a hopper dredge. Hopper dredges are designed to hydraulically dredge sediments, load and retain solids in the hoppers, and then haul them to the disposal site where disposal is accomplished by dumping through doors in the bottom of the hoppers or through the hull. For the interior river reaches, shoal material is usually removed by clamshell or bucket dredge. Dredged materials are mechanically picked up by the bucket and placed into a 2,000 to 6,000 cubic yard capacity scow moored next to the dredge. When full, the scow is pulled by a tug to the ODMDS and the load discharged through the bottom of the scow.

#### **Management Concerns or Issues**

**Wood Debris.** Shrimp fishermen fishing areas near the Wilmington ODMDS have reported fouling and tearing of their nets with roots, tree limbs, and other natural origin wood debris. These traditional trawling areas are being used but at a risk of loss or damage to nets and equipment. The fishermen attribute the wood debris to the ocean disposal of dredged material from the "river" reaches of the Wilmington Harbor navigation channel and MOTSU. The Wilmington ODMDS is immediately adjacent to traditional shrimp trawling areas.

In 1987-88 wood debris complaints from shrimp fishermen trawling in the vicinity and subsequent examination of the dredged material dump logs revealed that 12 scow loads were "short dumped" (i.e., outside the disposal area). The dredging contractor was required to conduct a clean-up of the short dump areas using heavy-duty scallop-style nets for 20 days (approximately 228 tows were made). Based on the 1987-88 incident and in order to maximize the distance from the disposal location to the shrimp fishing area, dredged materials from the river sources have, since about 1990, been placed in the most seaward (southern) half of the ODMDS. The North Carolina Division of Marine Fisheries reports that there were few complaints received until 1996 when the number of complaints increased dramatically. In June and July 1996, the Wilmington District CE employed two trawlers to drag heavy-duty nets in the shrimp-trawling areas in order to assess the wood debris problem. Trawling with heavy-duty nets revealed that

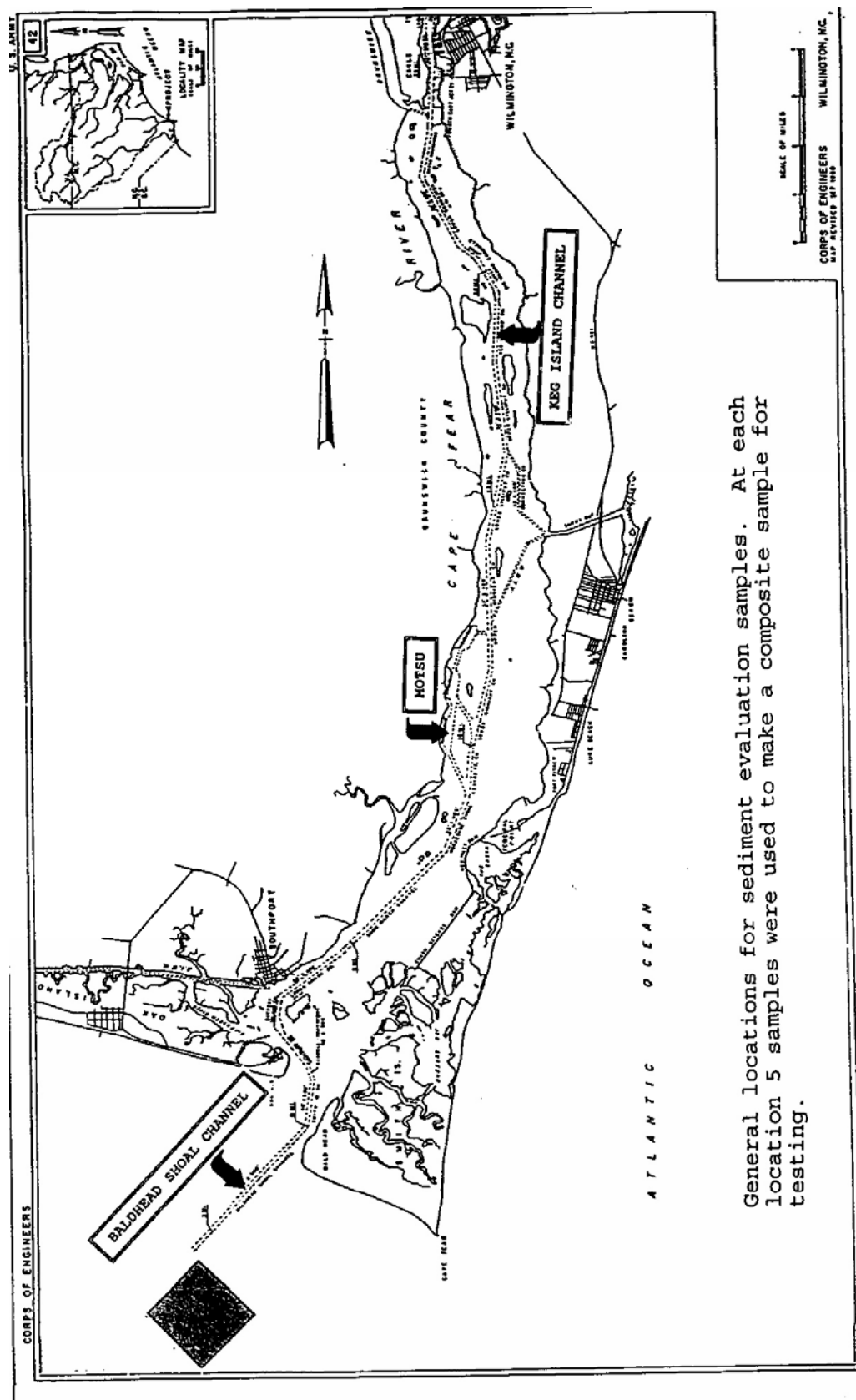


Figure 7. Sediment sample locations post-1990.

wood debris was present in the traditional shrimping bottoms and in sufficient amounts to interfere with shrimping. The wood debris trawling did not provide sufficient information to determine the source of the wood debris. The theory that the dredged material placed within the ODMDS is a source which supplies wood debris in pulses or continuously to the shrimpers' towing bottoms was neither confirmed nor rejected. Two extreme weather events, hurricanes Bertha and Fran passed over the area during the summer of 1996. These storms may have affected the distribution of wood debris, whatever its source. The CE is planning to conduct additional studies in 1996-97 to assess the wood debris issues including the source and distribution of wood debris.

**Mounding.** Bathymetric surveys have shown that appreciable mounding of dredged material, particularly sandy and coarse materials, has occurred where small specific areas within the ODMDS have been repeatedly used for disposal. For example, a sharp mound with a peak sounding of -17.1 feet m.l.l.w. was surveyed in April 1994. This was apparently the result of ocean disposal of about 1 million cubic yards of Wilmington Harbor ocean bar material within a small area in early 1994. A follow up bathymetric survey in February 1996 indicated that the mound had flattened to about -20.0 feet m.l.l.w. Such mounds may limit future use of those areas of the ODMDS and may pose an impairment to navigation including use by hopper dredges and tugs pulling scows.

**Dumps Outside the ODMDS.** Since 1987, a few dredged material loads have been reported as placed outside the Wilmington ODMDS. Based on a review of recent dump records, there appear to be two main reasons for the misplaced materials, operator errors and equipment errors or equipment limitations. Operator errors occur when a person, the equipment operator, does not correctly carry out the ocean disposal specifications. For example, the operator may not have the correct coordinates of the disposal area. Equipment errors occur when equipment malfunctions or a misunderstanding of equipment limitations takes place. For example, the dump scow activates or dumps erroneously or the dump target is placed at the edge of the disposal area without adequate margins for mechanical or sea conditions and the dump vessel overshoots the dump area.

**Rock Dredged Materials.** Recent improvements to the ocean bar channel and the proposed deepening of the Wilmington Harbor project involve the removal of rock, principally fossiliferous limestones. The disposal of these materials in the ODMDS would mean that a significant opportunity for beneficial uses of dredged material would not be utilized. Also, continued use of the Wilmington ODMDS as a disposal area is affected by either expending of capacity or, more critically, the potential development of hard-substrate habitat within its limits. Either of these effects have adverse long-term consequences.



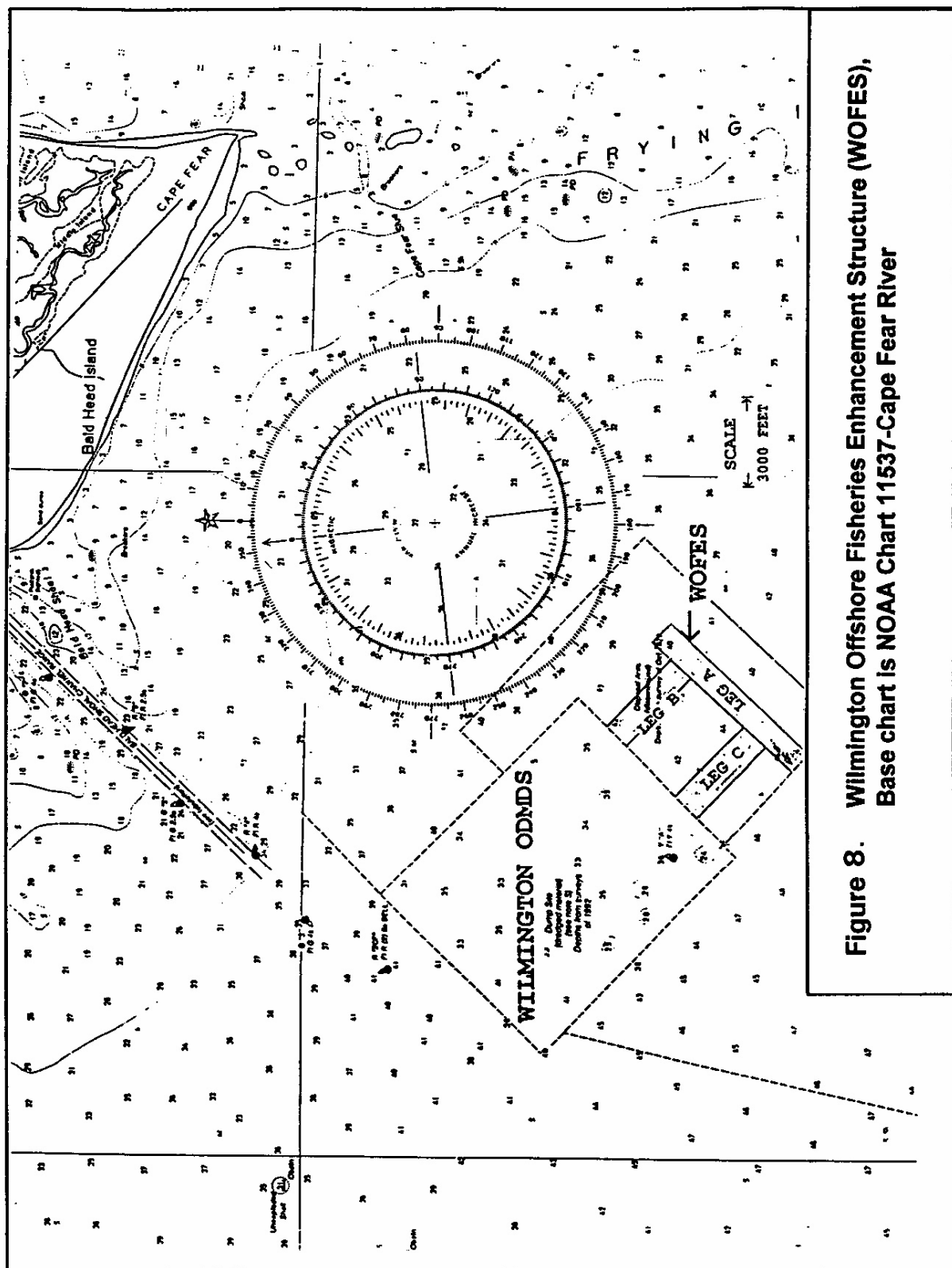


Figure 8. Wilmington Offshore Fisheries Enhancement Structure (WOFES),  
Base chart is NOAA Chart 11537-Cape Fear River

By the end of 1996, approximately 1,000,000 cubic yards of rock from the Wilmington Harbor Ocean Bar Channel deepening project will be placed to construct a fisheries enhancing structure hereafter referred to as the Wilmington Offshore Fisheries Enhancing Structure (WOFES). The WOFES is being built in an area immediately to the east of the Wilmington ODMDS (Figure 8). The dredged material is being discharged so that it will mound and create topographic relief in a designated pattern.

## OCEAN DREDGED MATERIAL SITE MANAGEMENT

All ocean disposal at the Wilmington ODMDS must be conducted in accordance with the Ocean Dumping Regulations and Criteria (40 CFR Parts 220-229), whether conducted as a permit activity or as a Federal activity. The following are Wilmington ODMDS management requirements and all permit or evaluations concurrences shall be conditioned to include these requirements.

### **Types of Dredged Materials To Be Disposed**

**Evaluated Material.** Only dredged materials which have been evaluated in accordance with EPA's Ocean Dumping Regulations and Criteria and found acceptable will be accepted for unrestricted disposal in the Wilmington ODMDS.

Guidance for evaluation of dredged materials under the MPRSA Section 103 program is provided in the Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual, February 1991 and the Regional Implementation Manual, Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Materials in Southeastern Atlantic and Gulf Coastal Waters, May 1993. The determination of dredged material suitability for ocean disposal must be documented in a MPRSA Section 103 evaluation and approved by EPA Region IV prior to disposal.

Dredged materials will be reevaluated for suitability for ocean disposal in accordance with current CE/EPA guidance at an interval not to exceed three years. Reevaluation and testing procedures should be coordinated with the Wilmington District CE and EPA Region IV before any sampling or testing.

**Dredged Material Suitable for Beneficial Uses.** Beneficial uses refers to the concept that dredged material can be disposed of in a way that is economically and environmentally acceptable and accrues natural resource benefits to society. Beneficial uses of dredged material proposed for ocean disposal must be considered.

Beach-compatible dredged materials (sands) dredged from the ocean bar or river navigation channel should be placed on nearby beaches or within the active littoral system when it is economically feasible and environmentally acceptable to do so. Site capacity and mounding problems are favorably affected by not placing beach compatible sands in the ODMDs. Other beneficial uses of dredged materials, such as their use to enhance or develop fisheries resource features (reefs or berms), use to restore colonial nesting waterbird islands in the Cape Fear River, or use as building material or soil, are also encouraged with appropriate environmental review.

**Dredged Material With Wood Debris.** If significant quantities of debris (either wood or man-made) are present in the dredged materials, then debris management which reduces the unacceptable effects must be conducted. Significant quantities of debris are considered to be those which demonstrably, materially, and unreasonably interfere with fishing in areas near the ODMDs. A goal of debris management will be to avoid or minimize adverse effects to shrimping grounds. Debris management may include one or more of the following:

- Removal of the debris from the dredged material before transportation to the ODMDs;
- Placement of dredged material in the ODMDs in a location (e.g., farthest distance possible from the fishing areas) such that debris interference with nearby fishing areas is unlikely;
- Immobilizing the debris within the ODMDs by covering it (capping) with dredged material.

In the event debris management actions do not prove effective in reducing adverse effects of debris shown to be coming from dredged material being placed in the Wilmington ODMDs to a level which does not unreasonably interfere with fishing, the Wilmington District CE and EPA Region IV shall explore additional measures to reduce debris effects, including alternative sites for disposal of dredged material containing significant quantities of wood debris.



**Methods of Disposal.** No specific disposal method is required for this site. Disposal may be by hopper dredge, dump scow, or by pipeline discharge. Dredged materials will be discharged within the ODMDS boundaries. The placement of dredged materials outside the ODMDS boundaries is not acceptable under MPRSA authorities. An approved ocean disposal verification plan must be carried out. Placement methods which prevent mounding of dredged materials from becoming an unacceptable navigation hazard will be used. Placement methods which reduce interference with fishing in adjacent areas will be used. Specific procedures which accomplish these goals are discussed under the **Specific Requirements** section which follows.

**Disposal Quantities.** Quantities of dredged materials placed within the ODMDS will be limited to those amounts that do not produce unacceptable adverse effects to human health and welfare and the marine environment or human uses of that environment (as defined in EPA's Ocean Dumping Regulations and Criteria). The disposal quantity management objective for the Wilmington ODMDS is to regulate disposal quantities such that depths in the disposal area following disposal do not interfere with navigation. The disposal depth limitation will be -25 feet m.l.l.w. Current average depths in the ODMDS are approximately -37 feet m.l.l.w.

**Timing of Disposal.** There are no seasonal restrictions to the placement of dredged material within the Wilmington ODMDS. However, seasonal restrictions and seasonal special requirements apply to particular dredging activities at particular locations.

**Disposal Buoy.** A US Coast Guard (USCG) Nun buoy ( yellow "A", flashing 4 seconds yellow ) has been placed within the Wilmington ODMDS. This buoy's purpose is primarily to alert ships to the presence of the ODMDS. Accurate microwave line-of-sight or differential global positioning system is required for all disposal vessels. However, the disposal buoy is available as a backup point of reference if the disposal vessel positioning systems fail.

### **Specific Requirements**

**Ocean Disposal Verification.** The vessels used for dredge material disposal will be required to operate under an approved verification plan. The location and quantity of each disposal load placed within the Wilmington ODMDS must be maintained in a computerized data base. All exception loads (i.e., reported disposal out of the ODMDS boundaries or no location reported) will be documented and the disposal operator questioned to determine what occurred and the reason for the exception. The verification plan will include an automated system that will record the horizontal location and draft condition of the disposal vessel from the time it passes Buoy "11" in Baldhead Shoal Channel outbound until the vessel passes Buoy "11" inbound. Vessel positioning as a minimum shall be either a microwave

line-of-sight system or differential global positioning system. Minimum required data for each load is as follows:

- Dredge or vessel name;
- Sequential load number;
- Date;
- Time, vessel position, and draft - in one minute  
intervals for the disposal cycle specified previously,  
positioning in North Carolina state plane coordinates,  
draft in feet;
- Begin and end dump event times and positions;
- Source of dredged material, i.e., reach name;
- Volume of dredged material disposed.

These data shall be available on a daily basis. No vessel shall leave for the disposal site without the ability to collect and record the ocean disposal verification data specified. The disposal positions reported shall be those of the disposal vessel itself (i.e., the scow not the tug).

In addition, a summary report of operations shall be provided by the Wilmington District CE to the EPA, Region IV, Ocean Dumping Coordinator at the completion of the dredging/ocean disposal project or activity. For work under a Section 103 permit, the permit holder will be responsible for providing the requested information to the CE. Minimum required data to be included in the summary report is as follows:

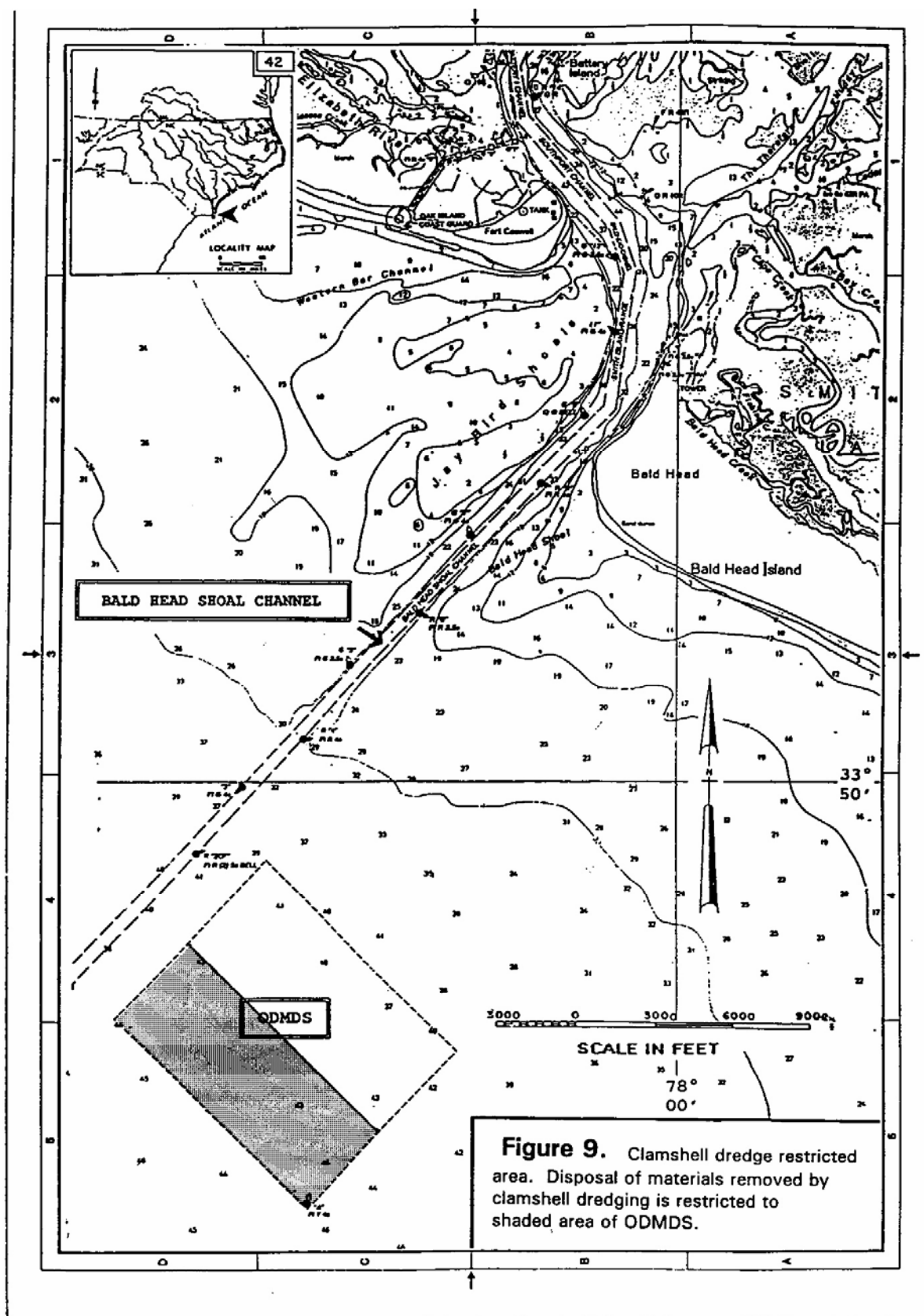
- General Information
  - 1). Project name;
  - 2). Location;
  - 3). Public notice or permit date;
  - 4). Section 103 evaluation date;
- Disposal Site Used;
- Project Type - Either Federal or Section 103 permit;
- Type of Work - New or maintenance work;
- Method of Dredging and Disposal;
- Disposal Dates - Range of disposal dates - start to finish;
- Quantity of Dredged Material Disposed - in cubic yards;
- Point of Contact for Project.

**Designated Route To and From the Wilmington ODMDs.** A transportation route to and from the Wilmington ODMDs will be specified to reduce possible interferences with nearby fishing grounds. The transportation route is the Wilmington Harbor navigation channel to approximately buoy "5" after which a turn and direct course to the ODMDs can be made. The return route will be the same. A transportation corridor parallel to the Wilmington Harbor channel and within 1000 feet of the channel may be used when maintenance dredging in the channel or traffic presents a hazard to safe navigation. The ocean disposal verification plan discussed previously provides verification that the approved route was taken.

**Disposal "Zones" Within the ODMDs.** To manage site use, for example, maximize site capacity, reduce multiple user conflicts, simplify monitoring and management, and reduce potential adverse impacts to the marine environment, the Wilmington District CE in consultation with EPA Region IV will designate zones within the ODMDs for dredged materials from each specific ocean dumping activity. Site monitoring data will be used to adjust these zones relative to current site conditions.

Disposal zones will be designated in the seaward half of the ODMDs for materials dredged during channel maintenance by clamshell dredge (Figure 9). Hopper dredged materials may be placed anywhere within the ODMDs. The northern ODMDs boundary is adjacent to traditional shrimp trawling areas. Clamshell dredging, which occurs principally in the riverine channel areas, may encounter and entrain greater amounts of wood (tree limbs, roots, etc.) debris naturally found on the river bottom than hopper dredging methods which principally take place on the ocean bar. These site use provisions may reduce potential interferences attributed to the fouling of fishing nets with wood debris. See **Dredged Material With Wood Debris** on page 11.

**Control of Mounding.** Dredged material shall be placed so that at no point will depths less than -25 feet m.l.l.w. occur (i.e., a clearance of 25 feet above the bottom will be maintained). To maximize ODMDs capacity and minimize mounding of material, the dumps shall be scattered throughout designated disposal zones and not placed repeatedly at one location. The disposal zones may be divided into several disposal cells or quadrants which will be sequentially used to ensure dispersal or spreading of the dredged material rather than mounding. Depths at the time of disposal will be monitored to detect if adjustment of disposal methods is needed to prevent unacceptable mounding. While control of placement to minimize mounding is preferred, the physical removal or leveling of material above -25 feet m.l.l.w. is a management alternative should mounds greater than those elevations occur.



**Emergency Dumps.** If a Wilmington ODMDS user experiences an emergency which causes a dumping of material outside the ODMDS, the site user must notify the EPA Region IV, Ocean Dumping Coordinator (and the Wilmington District CE Ocean Dumping Coordinator for a Section 103 permit activity) and provide in writing within 2 days of the emergency dump, the reason for the emergency, and the location of the dump. If, in the opinion of EPA, the misplaced dredged materials are a hazard to the marine environment and its uses, the site user shall remove such material and deposit it where directed.

## **BASELINE ASSESSMENT OF CONDITIONS AT THE WILMINGTON ODMDS**

**Site Designation EIS Baseline.** Baseline conditions at the Wilmington ODMDS are principally reported in the site designation final environmental impact statement, Savannah, GA, Charleston, SC, and Wilmington, NC Ocean Dredged Material Disposal Site Designation, October 1983. This baseline data includes information referenced from the scientific literature and information compiled from field surveys at the Wilmington ODMDS. The field survey data included: water and sediment chemistry; benthic macroinfauna and epifauna population characteristics; and concentrations of trace metals and chlorinated hydrocarbons in benthic macroinfauna tissues.

**Information Obtained Since Site Designation.** Site evaluations and monitoring since the site designation have produced supplemental information in the following areas.

**Bathymetry.** Bathymetric surveys have generally been conducted annually by the CE since the site designation. A bathymetric survey of the Wilmington ODMDS area conducted in October 1979 indicated an average depth of about -40 feet mean low water (m.l.w.), with a range of depths from about -39 to -44 feet m.l.w. (note: at this location m.l.w. datum is essentially equal to m.l.l.w. which is the datum used for current navigation charts). A survey of the ODMDS in February 1996 revealed an average depth of about -37 feet m.l.l.w., with a range of depths from -44 to -20 feet. These surveys show that dredged materials have been retained in the site for a period spanned by the two surveys. The bathymetric surveys also show that appreciable dredged material mounds occur within the ODMDS. Figures 10 and 11 illustrate bathymetry of the Wilmington ODMDS based on the February 1996 survey.

**Sediment Characterizations.** Sediment characterizations, by grain size distributions, near the Wilmington ODMDS indicate that the site is located in an area of transition between a band of fine grained muds and silty sands which occur north of the ODMDS and paralleling the coast about 1.5 nautical miles (nmi) offshore and fine to medium sands with shell further offshore (USACE/EPA 1986, USACE 1991, EPA 1992, EPA 1993). Hard bottom or reef-rock materials have not been reported in the sediment characterizations which together extend at least 0.5 nmi beyond the limits of the ODMDS in all directions



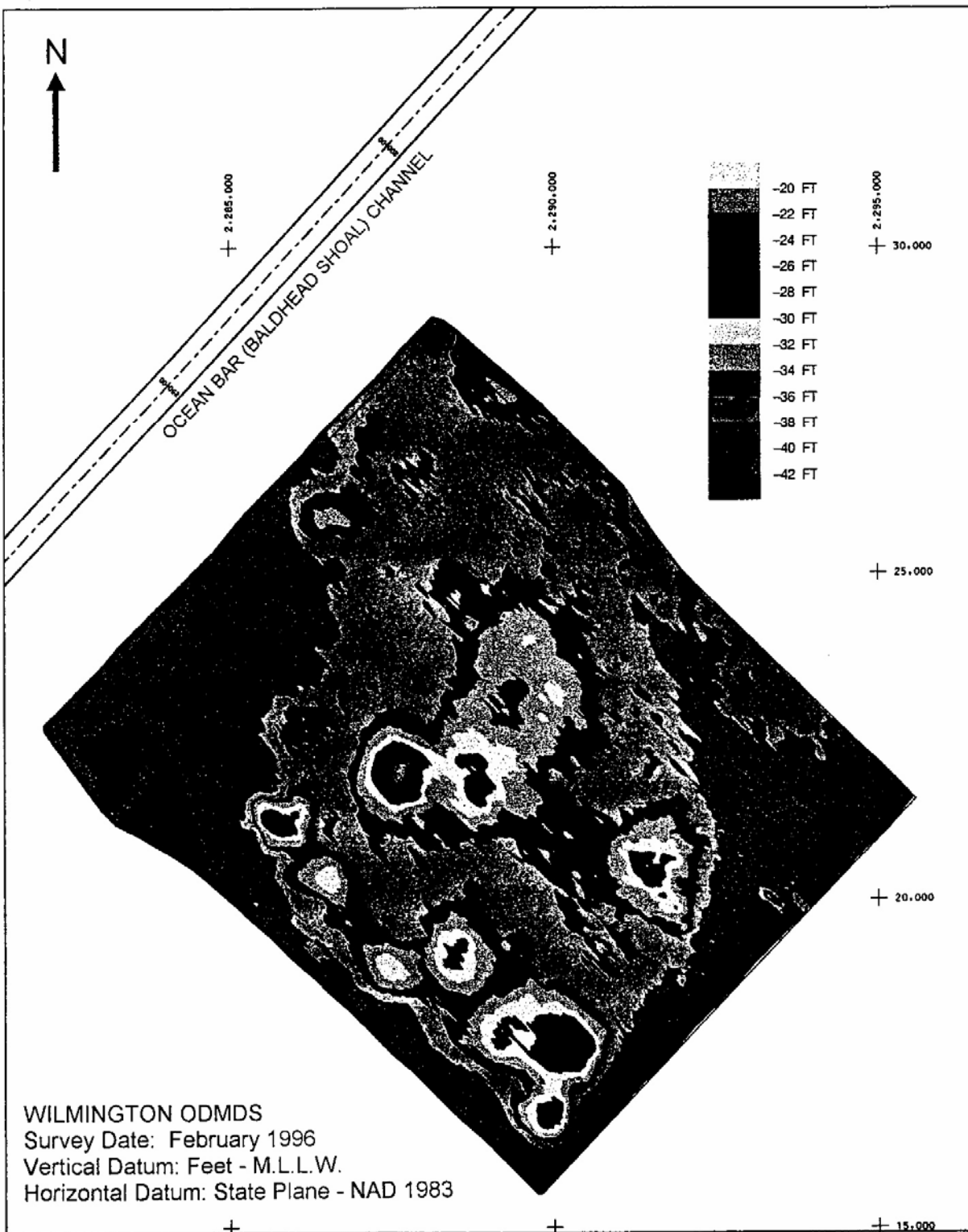


Figure 10.

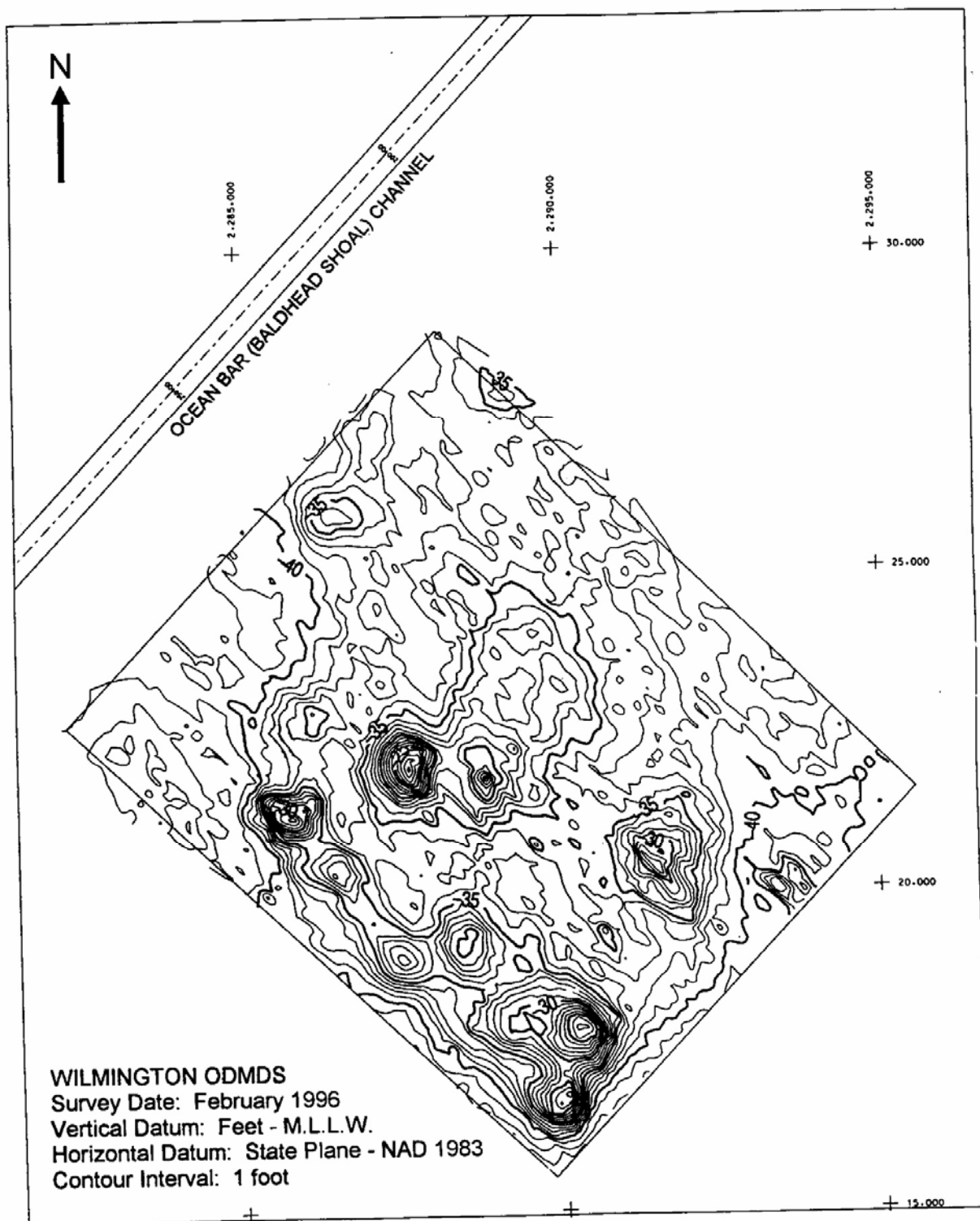


Figure 11.

and in some cases extend several nautical miles beyond the ODMDS limits.

In May 1992, EPA conducted real time sediment mapping of Wilmington ODMDS using a towed sled with gamma spectroscopy capabilities (the Gamma Isotope Mapping System (GIMS) and x-ray fluorescence (XRF) of samples taken continuously during the survey (EPA 1992). These data may be used as a baseline for future sediment mapping of this type.

**Benthic Communities.** Benthic communities of the Wilmington ODMDS area were sampled in 1979 (EPA 1983 and USACE 1980) and 1992 (EPA 1993). These studies revealed a highly variable spatial distribution of benthic organisms. No significant relationships between infaunal assemblages and abiotic factors (physical and chemical composition of sediments) have been detected probably due to the cosmopolitan (heterogenetic) character of the infaunal assemblages present. Similarly, no relationship between previous dredged material disposal and infaunal assemblages or abundance/diversity has been detected. Most of the taxa reported during the above referenced surveys were annelids, (particularly polychaete species) molluscs, and arthropods. Species abundance in September 1992 samples varied from 32 to 99 (6.1 to 22.1 mean taxa per replicate) and mean density ranged from 658 to 5806 individuals/m<sup>2</sup> (EPA 1993).

Data on hard bottom locations in North Carolina waters (i.e., within three nautical miles of shore) has been collected from the scientific community, SCUBA divers and dive shops, and recreational and commercial fishermen by Moser and Taylor (1994). This preliminary database contained 2 records in the vicinity of the Wilmington ODMDS. These records were located approximately 1 nautical mile northeast of the Wilmington ODMDS.

## SITE MONITORING

**Goals of Site Monitoring.** Site monitoring is conducted to ensure the environmental integrity of an ocean dredged material disposal site and to verify compliance with site designation criteria, any special site management conditions, and with permit conditions or federal authorization requirements. Monitoring should provide useful and pertinent information to support site management decisions. The main purpose of a disposal site monitoring program is to determine whether site management practices, including disposal operations, need to be changed to avoid unacceptable impacts or to provide benefits to resource conditions. Site monitoring is not a stand alone activity. It is based on the site designation process, the characteristics of the dredged materials, and compliance with authorized activities.

To use site monitoring as an effective tool, site managers need to define in quantitative terms thresholds for unacceptable impacts and desired beneficial effects of dredged material disposal.



Exceeding or not exceeding the thresholds triggers specific management actions. A tiered strategy for a monitoring program is desirable. With a tiered approach, an unacceptable result may trigger further and often more complex monitoring. Continuous monitoring of all physical, chemical, and biological parameters and resources in and around the ocean dredged material disposal site is not necessary. A monitoring program should be structured to address specific questions (hypotheses) and measure key indicators and endpoints, particularly those defined during site designation or specific project issues that arise. For the Wilmington ODMDS, the site designation environmental impact statement (EPA 1983) identified navigation and fishing (shrimping) in adjacent waters as resources of concern.

**Wilmington ODMDS Monitoring Objectives.** The objectives of the site monitoring plan for the Wilmington ODMDS are to provide information to:

- Determine if the disposal activities are in compliance with site use restrictions and permit conditions;
- Determine the short and long-term fate of dredged materials placed at the site;
- Determine the effect of the dredged material disposal on uses of the marine environment within and outside the ODMDS.

**Monitoring Methods and Rationale.** Monitoring strategies are proposed for the Wilmington ODMDS and thresholds for management actions are presented in Table 4 and discussed in the following paragraphs. These methods will provide information to address specific and current management issues at the site including; mounding (and site capacity); wood debris in dredged materials being transported to shrimping grounds; dumps occurring outside the disposal area; and movement or fate of material. As indicated in Table 4, information obtained during monitoring may indicate the need for additional monitoring at a higher, more complex, level. If more intensive monitoring is required, this monitoring plan must be revised and additional thresholds for action established.

**Site Bathymetry.** Within three (3) months before the beginning and three months after the completion of a disposal event, a detailed bathymetric survey of the ODMDS and a 0.25 NM wide area around the site will be conducted. Horizontal location of the survey lines and depth sounding points will be determined by an automated positioning system utilizing either a microwave line of sight system or a differential global positioning system. Survey line spacing will be at most 250 feet. The vertical datum shall be mean lower low water (m.l.l.w.) and the horizontal datum North Carolina State Plane, NAD 1983.

The survey data will be made available as a coordinate data file in an electronic format specified by the Wilmington District CE and EPA Region IV. Pre-disposal and post-disposal surveys will be evaluated using surface modeling techniques. Consecutive surveys will be compared to establish

apparent net direction of sediment movement. Estimates will be made of the quantities and types of materials retained within the ODMDS as compared to those dispersed off site. The ocean disposal verification data base will be used to associate dredging project information with bathymetric features observed.

**Evaluation of Direction and Magnitude of Material Movement.** The extent and probable direction in which local waves and currents erode and transport the dredged material mounds may be important in determining potential effects of site use on adjacent marine resources and in managing use of the site. Sediment dispersion can increase site capacity but also make material available for transport to undesirable locations. Numerical simulation models such as LTFATE and MDFATE which couple hydrodynamic and sediment transport equations can be used to evaluate dredged material movement at the Wilmington ODMDS. These models are included in the CE' PC based Automated Dredging and Disposal Alternatives Modeling System (ADDAMS). These evaluations will be conducted by the Wilmington District CE and EPA Region IV as appropriate.

**Other Survey Techniques.** Additional survey techniques such as side scan sonar, video records, still photography, bottom grab samples, and vertical sediment profiling will be used as necessary to determine the effects of disposal in the Wilmington ODMDS. Questionnaire surveys of shrimp trawlers or trawling surveys may also be used. These methods will be aimed at addressing the wood debris management issues such as the extent and persistence of the adverse effects and possible ways to mitigate those effects. The use of these techniques will be coordinated with Wilmington District CE and EPA Region IV.

**Disposal Site Use Records.** All dredged material disposal activities at the Wilmington ODMDS will be conducted under an approved verification plan. The Wilmington District CE will maintain a database of site use. The documented site use information along with other information collected during monitoring will be used to direct future ocean disposal and monitoring activities. The data requirements were discussed previously.

**Data Reporting.** An annual summary report of monitoring activities and results shall be prepared by the Ocean Dumping Coordinators of the Wilmington District CE and EPA Region IV.

## **ANTICIPATED SITE USE**

It is anticipated that use of the Wilmington ODMDS will continue for many years. Projected Wilmington ODMDS use for the next 10 years (1996 through 2005) is given in Table 5. The projections are based on 1970-1994 dredging records, currently available dredged material disposal options, and

Wilmington District CE planning documents. These estimates likely represent the high end of the potential range of quantities as efforts are underway to develop alternative dredged material disposal methods, particularly for mid-river areas and areas where sandy sediments predominate.

### **MODIFICATION OF THE WILMINGTON ODMDS SMMP**

Should the results of the monitoring surveys or valid reports from other sources clearly demonstrate that continued use of the ODMDS would lead to unacceptable effects, then the ODMDS management will be modified to mitigate the adverse effects. The SMMP will be reviewed and updated at least every 10 years. The SMMP will be reviewed and updated as necessary if site use changes significantly. For example, the SMMP will be reviewed if the quantity or type of dredged material placed at the site changes significantly or if conditions at the site indicate a need for revision. Management may include regulating the quantity and type of dredged material placed at the Wilmington ODMDS to the point that the site is no longer adequate and the designation of a new site or enlargement of the existing site may be necessary. The SMMP should be updated in conjunction with activities authorizing use of the site.

### **IMPLEMENTATION OF THE WILMINGTON ODMDS SMMP**

This plan shall be effective from date of signature for a period not to exceed 10 years. The EPA and the CE shall share responsibility for implementation of the SMMP. Site users may be required to undertake monitoring activities as a condition of their permit. The CE will be responsible for implementation of the SMMP for Federal maintenance and new work projects.

Table 4. Wilmington ODMDS Monitoring Strategies and Thresholds for Action.

STRATEGY	THRESHOLD	MANAGEMENT OPTIONS	
		Threshold Not Exceeded	Threshold Exceeded
Monitoring Strategy Site Bathymetry	Predefined Threshold for Action Mound height > -25' m.l.l.w.	<ul style="list-style-type: none"> <li>Continue monitoring after each disposal activity (project completion)</li> <li>Continue monitoring after each disposal activity (project completion)</li> </ul>	<ul style="list-style-type: none"> <li>Move disposal points within site</li> <li>Limit quantity of material</li> <li>Remove material above -25' m.l.l.w.</li> <li>Cease use of specific area of site</li> <li>Continue monitoring mound status</li> <li>Notify mariners of mound location and height</li> <li>Move disposal points within site</li> <li>Continue use of area but increase frequency of monitoring</li> <li>Limit dredged material quantities placed at site</li> </ul>
Site Bathymetry - Sequential Surveys analysis	Sequential surveys indicate movement of material to navigation channel or fishing grounds	<ul style="list-style-type: none"> <li>Continue monitoring after each disposal activity (project completion)</li> <li>Continue monitoring at a reduced level</li> <li>Stop monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Move disposal points within site</li> <li>Increase monitoring level to assess impacts of material movement</li> <li>Reduce quantities placed at site</li> </ul>
Other Survey Techniques	Clear indication that dredged material derived debris is in or moving towards fishing areas north and east of ODMDS	<ul style="list-style-type: none"> <li>Continue monitoring at a reduced level</li> <li>Stop monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Increase level of monitoring</li> <li>Implement a removal or remediation action</li> <li>Reduce quantities of debris associated with dredged material</li> </ul>
Disposal Site Use Records	Disposal records required by SMMP are not submitted or are incomplete  Review of records indicates a dump occurred at a location other than as directed	<ul style="list-style-type: none"> <li>Continue monitoring at same level</li> <li>Continue monitoring at same level</li> </ul>	<ul style="list-style-type: none"> <li>Restrict site use until requirements are met</li> <li>Dump occurred outside ODMDS boundary Notify EPA-Region IV and State of NC Investigate why egregious dump(s) occurred Remove material from egregious dump(s) if a hazard to navigation or the environment</li> <li>Dump occurred in ODMDS but not in target area Direct placement to occur as specified</li> </ul>
Evaluation of Direction and Magnitude of Material Movement Using Numerical Models	Evaluations indicate the potential to move back to navigation channel or to adjacent fishing areas	<ul style="list-style-type: none"> <li>Continue monitoring at a reduced level</li> <li>Stop monitoring</li> <li>Continue monitoring at same level</li> </ul>	<ul style="list-style-type: none"> <li>Increase level of monitoring</li> <li>Collect additional information needed to refine predictions</li> <li>Change operational considerations, i.e., location and method of placement</li> </ul>

Table 5. Wilmington ODMDS projected site use 1996-2005. Projections based on 1970-1994 dredging records and Wilmington District planning documents.

YEAR	PROJECT/PORTION OF PROJECT	TYPE OF WORK	DREDGING METHOD	ESTIMATED QUANTITIES (MILLION CUBIC YARDS)
1996	Wilmington Harbor Ocean Bar	Maintenance	Hopper	0.7
	Wilmington Harbor Ocean Bar Deepening	New Work	Hopper	0.6
	Wilmington Harbor 38-Foot	Maintenance	Bucket and Barge	0.3
	MOTSU Harbor Improvements	New Work	Bucket and Barge	4.3
		1996 TOTALS		Maintenance 1.0 New Work 4.9 TOTAL 5.9
1997	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0
	MOTSU	Maintenance	Bucket and Barge	1.0
		1997 TOTALS		Maintenance 2.0 New Work 0.0 TOTAL 2.0
1998	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0
	Wilmington Harbor 38-Foot	Maintenance	Bucket and Barge	0.5
	Wilmington Harbor Channel Widening	New Work	Bucket and Barge	1.0
	MOTSU	Maintenance	Bucket and Barge	1.0
		1998 TOTALS		Maintenance 2.5 New Work 1.0 TOTAL 3.5
1999	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0
	Wilmington Harbor Channel Widening	New Work	Bucket and Barge	1.3
	MOTSU	Maintenance	Bucket and Barge	1.0
		1999 TOTALS		Maintenance 2.0 New Work 1.3 TOTAL 3.3
2000	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0
	Wilmington Harbor 38-Foot	Maintenance	Bucket and Barge	0.5
	Wilmington Harbor Channel Widening	New Work	Bucket and Barge	1.3
	MOTSU	Maintenance	Bucket and Barge	1.0
		2000 TOTALS		Maintenance 2.5 New Work 1.3 TOTAL 3.8

(continued on next page)



Table 5 (continued). Wilmington ODMDS projected site use 1996-2005. Projections based on 1970-1994 dredging records and Wilmington District planning documents.

YEAR	PROJECT/PORTION OF PROJECT	TYPE OF WORK	DREDGING METHOD	ESITMATED QUANTITIES (MILLION CUBIC YARDS)	
2001	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0	
	Wilmington Harbor Channel Comprehensive	New Work	Bucket and Barge	1.6	
	MOTSU	Maintenance	Bucket and Barge	1.0	
		2001 TOTALS		2.0	
				Maintenance New Work TOTAL	1.6 3.6
2002	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0	
	Wilmington Harbor 38-Foot	Maintenance	Bucket and Barge	0.5	
	Wilmington Harbor Channel Comprehensive	New Work	Bucket and Barge	2.0	
	MOTSU	Maintenance	Bucket and Barge	1.0	
		2002 TOTALS		2.5	
			Maintenance New Work TOTAL	2.0 4.5	
2003	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0	
	Wilmington Harbor Channel Comprehensive	New Work	Bucket and Barge	2.0	
	MOTSU	Maintenance	Bucket and Barge	1.0	
		2003 TOTALS		2.0	
				Maintenance New Work TOTAL	2.0 4.0
2004	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0	
	Wilmington Harbor 38-Foot	Maintenance	Bucket and Barge	0.5	
	Wilmington Harbor Channel Comprehensive	New Work	Bucket and Barge	0.5	
	MOTSU	Maintenance	Bucket and Barge	1.0	
		2004 TOTALS		2.5	
			Maintenance New Work TOTAL	0.5 3.0	
2005	Wilmington Harbor Ocean Bar	Maintenance	Hopper	1.0	
	MOTSU	Maintenance	Bucket and Barge	1.0	
		2005 TOTALS		2.0	
				Maintenance New Work TOTAL	0 2.0
	1996-2005 Projected TOTALS				Maintenance New Work TOTAL

## REFERENCES

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